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Use of NeutroAlgebra for the Analysis of the Poor State of the Social Rehabilitation System in Babahoyo

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Abstract. The objective of this work was to use the NeutroAlgebra theory to determine the factors with the highest incidence in the poor state of the social rehabilitation system in Ecuador. For this purpose, a survey was applied to a group of 56 experts in the field from the canton of Babahoyos. Neutrosophic Logic based on SVNS was applied to the DEMATEL method. The application of this method made it possible to determine the causal relationships between the initial elements and to focus the efforts of the interview on the causal elements of the main problems. Through the use of NeutroAlgebra it was possible to determine that, although in general, the results were satisfactory, unfavorable responses were observed in relation to the budget to carry out the different activities, the increase in crime in the country, as well as the lack of good prison reforms. The results allowed the fulfillment of the objectives and demonstrated the usefulness of neutrosophic logic in real-life problems.

Keywords: NeutroAlgebra, social rehabilitation, Ecuador.

1. Introduction

Faced with the advancement of various fields of research and the need to model increasingly complex problems that are associated with real life, the need to assume more varied criteria and alternatives has become more prevalent in all scientific fields. The presence of uncertain data or measurements has generated a great need to establish effective mechanisms for data measurement and has even given rise to new theories and fields of measurement [1].

In this scenario, a series of new theories emerged intending to provide a feasible solution to such drawbacks. In 1995, Smarandache extended paradoxism (based on opposites) to a new branch of philosophy called Neutrosophy. This new science was based on the study of the relationship between opposites and their neutrality. Neutrosophy is also an extension of Dialectic (characterized by the dynamics of opposites in Philosophy), and ancient Chinese Yin-Yang Philosophy (also based on opposites: masculine/feminine, good/bad, heaven/earth, etc.) which was founded and studied two and a half millennia before the Dialectics of Hegel and Marx [2].

After the initial contributions made by Smarandache, several neutrosophic notions have followed that provide a reasonable mathematical framework for dealing with indeterminate and inconsistent information [3]. Given its importance and applicability in multiple forms of science, engineering, and society, various specialists have expanded the neutrosophic model to extend its practical application [4]. These theories have shown multiple applications in engineering, computer science, administrative work, medical research, biology, psychology, social sciences, etc.

An example of this is the contribution made by [5], who extended the gray relational analysis method to the neutrosophic environment and applied it to the selection of the investment sector. Secondly, [2] developed the TODIM method using aggregate weight operators. On the other hand, the study carried out by [6] showed a new approach for multi-attribute group decision-making problems in the single-valued neutrosophic setting. In this way, they were used to catalog the alternatives according to certain criteria. This allowed the expression of expert opinion based on the information provided.

In 2019, due to the need to more accurately reflect reality, Smarandache first introduced the NeutroDefined and AntiDefined laws, as well as the NeutroAxiom and AntiAxiom, inspired by Neutrosophy, giving birth to new research fields called NeutroStructures and AntiStructures [7]. In this sense, the consideration of a given classical algebraic axiom began, defining for the first time, the neutrosophic triplet corresponding to this Axiom, (Axiom,

NeutroAxiom, AntiAxiom) [3].

In this sense, while the classical Axiom is 100% or totally true, the Neutral Axiom is partially true and partially false, which implies that the degrees of truth and falsehood are both > 0; while the AntiAxiom is 100% or totally false [8]. In this way, a (classical) algebraic structure is an algebraic structure that deals only with (classical) axioms, which are totally true. So, a NeutroAlgebraic Structure is an algebraic structure that has at least one NeutroAxiom and no AntiAxiom. While an AntiAlgebraic Structure is an algebraic structure that has at least one AntiAxiom [9].

These NeutroAlgebraic and Antialgebraic Structures were introduced, after being ignored by classical algebraic structures. Since, in the applications of everyday life, the laws that characterize them are not necessarily well defined or known, and the properties/theories that govern them might be only partially true and partially false (a mixture of truth and falsehood) [10].

Constitutionally, the social rehabilitation system of Ecuador has the purpose of achieving the comprehensive rehabilitation of people criminally sentenced to be reintegrated into society. Likewise, the protection of persons deprived of liberty and the guarantee of their rights are sought. In this sense, it is established that the system will have as a priority the development of the capacities of the criminally sentenced persons to exercise their rights and fulfill their responsibilities upon regaining their freedom.

However, most of the current Social Rehabilitation Centers do not provide the adequate conditions required by persons who are in prison, to enjoy a dignified life. Nor do they offer the ideal infrastructure to carry out rehabilitation programs and priority attention during the period of stay in detention centers. The system of corruption that operates in the Ecuadorian prison system, overcrowding, and poor living conditions, among other factors, has made it increasingly difficult to maintain control within the prisons.

In this sense, the present work has the objective of using the NeutroAlgebra theory to determine the factors of greater incidence in the deficient state of the social rehabilitation system of Ecuador. To carry out this study, it is decided to use and apply the survey to a group of experts in the field from the canton of Babahoyo.

To carry out the present study, the use of the linguistic scale is taken into account, which is a tool more natural for the human being, and that allows to express more reliably what is meant. For this, some notions of NeutroAlgebra are used. As a complementary method for decision-making, the DEMATEL method is used, in its neutrosophic variant. This method is a valuable tool for classifying the relationships between the objects, which makes it highly effective for data analysis and classification, in the decision-making process, etc. [11].

2. Prelims

Definition 1: Let X be a given nonempty space (or simply set) included in a universe of discourse U. Let <A> be an item (concept, attribute, idea, proposition, theory, etc.) defined on the set X. Through the process of neutrosophication, we split the set X into three regions [two opposite ones <A> and <antiA>, and one neutral (indeterminate) <neutA> between them], regions which may or may not be disjoint – depending on the application – but they are exhaustive (their union equals the whole space).

A NeutroAlgebra is an algebra that has at least one NeutroOperation or one NeutroAxiom (axiom that is true for some elements, indeterminate for other elements, and false for other elements).

NeutroAlgebra is a generalization of Partial Algebra, which is an algebra that has at least one Partial Operation, while all its Axioms are totally true (classical axioms).

Definition 2: A function $f: X \to Y$ is called a Partial Function if it is well-defined for some elements in X, and undefined for all the other elements in X. Therefore, there exist some elements $a \in X$ such that $f(a) \in Y$ (well-defined), and for all other element $b \in X$ we have $f(b)$ is undefined [12], [22], [24].

Definition 3: A function $f: X \to Y$ is called a NeutroFunction if it has elements in X for which the function is well-defined {degree of truth (T)}, elements in X for which the function is indeterminate {degree of indeterminacy (I)}, and elements in X for which the function is outer-defined {degree of falsehood (F)}, where $T, I, F \in [0, 1]$, with $(T, I, F) \neq (1, 0, 0)$ that represents the (Total) Function, and $(T, I, F) \neq (0, 0, 1)$ that represents the Anti-Function.

Classification of Functions

i) (Classical) Function, which is a well-defined function for all the elements in its domain of definition.

ii) NeutroFunction, which is a function partially well-defined, partially indeterminate, and partially outer-defined in its domain of definition.

iii) AntiFunction, which is a function outer-defined for all the elements in its domain of definition.

Definition 4: A (classical) Algebraic Structure (or Algebra) is a nonempty set A endowed with some (totally well-defined) operations (functions) on A, and satisfying some (classical) axioms (totally true) - according to the Universal Algebra [12].

Definition 5: A (classical) Partial Algebra is an algebra defined on a nonempty set PA that is endowed with some partial operations (or partial functions: partially well-defined, and partially undefined). While the axioms (laws) defined on a Partial Algebra are all totally (100%) true [12], [27].

Definition 6: A NeutroAxiom (or Neutrosophic Axiom) defined on a nonempty set is an axiom that is true for some set of elements {degree of truth (T)}, indeterminate for other sets of elements {degree of indeterminacy (I)}, or false for the other set of elements {degree of falsehood (F)}, where $T, I, F \in [0,1]$, with $(T, I, F) \neq (1,0,0)$ that represents the (classical) Axiom, and $(T, I, F) \neq (0,0,1)$ that represents the AntiAxiom [12], [23].

Classification of Algebras [9]

- A (classical) Algebra is a nonempty set CA that is endowed with total operations (or total functions, ie true for all set elements) and (classical) Axioms (also true for all set elements).
- A NeutroAlgebra (or NeutroAlgebraic Structure) is a nonempty set NA that is endowed with: at least one NeutroOperation (or NeutroFunction), or one NeutroAxiom that is referred to the set (partial-, neutral-, or total-) operations.
- An AntiAlgebra (or AntiAlgebraic Structure) is a nonempty set AA that is endowed with at least one AntiOperation (or AntiFunction) or at least one AntiAxiom.

Additionally, the PROSPECTOR function is defined in the MYCIN expert system in the following way; it is a mapping from $[-1,1]^2$ into $[-1,1]$ with the formula [13], [27]:

$$P(x,y) = \frac{x+y}{1+xy} \quad (1)$$

This function is a uninorm [14], with neutral element 0, thus it fulfills commutativity, associativity, and monotonicity. Here we respect the condition that $P(-1,1)$ and $P(1,-1)$ are undefined.

Otherwise, for convenience $P(x,y)$ is extended to $\bar{P}(x,y)$ such that:

$\bar{P}(x,y) = P(x,y)$ for all $(x,y) \in [-1,1]^2 \setminus \{(-1,1),(1,-1)\}$,

$\bar{P}(-1,1) = \bar{P}(1,-1) = undefined$,

$\bar{P}(undefined, undefined) = undefined$.

$$\bar{P}(undefined, x) = \bar{P}(x, undefined) = \begin{cases} \text{undefined, if x} > 0 \\ \text{x, if x} \leq 0 \end{cases}.$$

Definition 7: Let S be a finite set defined as $S = \left\{(x,y): x,y \in \left\{\frac{k}{10}, undefined\right\},\ k \in \mathbb{Z} \cap [-10,10]\right\}$.

The operator $\odot$ is defined for every $(x,y) \in S$, such that [15]:

1. If $\bar{P}(x,y)$ is not undefined, then $\odot\, y = \frac{round(\bar{P}(x,y)*10)}{10}$, where *round* is the function that outputs the integer nearest to the argument.
2. If $\bar{P}(x,y)$ is undefined then $x \odot y = undefined$.

Then $\odot$ is a finite NeutroAlgebra. This is because $\odot$ is commutative and associative for the subset of elements of S without any undefined component, but it is not associative otherwise.

E.g., if $a = -0.9$, $b = 0.8$, $c = undefined$, then $a \odot (b \odot c) = a$ and $(a \odot b) \odot c = -0.4 \neq a$, therefore associativity is a NeutroAxiom.

Function *round* is used for guarantying $\odot$ is an inner operator.

In this case, Caley tables are used to generate data at the same scale used in the input data. To do this, these elements are multiplied by 10, so that input values can be obtained in a range from -10 to 10. Table 1 shows the results of this operation.

$x \odot y$	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	I	1	2	3	4	5	6	7	8	9	10
-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	I
-9	-10	-10	-10	-10	-10	-10	-10	-9	-9	-9	-9	-9	-9	-9	-8	-8	-7	-7	-5	-4	0	10
-8	-10	-10	-10	-10	-9	-9	-9	-9	-9	-8	-8	-8	-8	-7	-7	-6	-5	-4	-2	0	4	10
-7	-10	-10	-10	-9	-9	-9	-9	-8	-8	-7	-7	-7	-6	-6	-5	-4	-3	-2	0	2	5	10
-6	-10	-10	-9	-9	-9	-8	-8	-8	-7	-7	-6	-6	-5	-5	-4	-3	-1	0	2	4	7	10
-5	-10	-10	-9	-9	-8	-8	-8	-7	-6	-6	-5	-5	-4	-3	-2	-1	0	1	3	5	7	10
-4	-10	-10	-9	-9	-8	-8	-7	-6	-6	-5	-4	-4	-3	-2	-1	0	1	3	4	6	8	10
-3	-10	-9	-9	-8	-8	-7	-6	-6	-5	-4	-3	-3	-2	-1	0	1	2	4	5	7	8	10
-2	-10	-9	-9	-8	-7	-6	-6	-5	-4	-3	-2	-2	-1	0	1	2	3	5	6	7	9	10
-1	-10	-9	-8	-7	-7	-6	-5	-4	-3	-2	-1	-1	0	1	2	3	4	5	6	8	9	10
I	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	I	I	I	I	I	I	I	I	I	I	I
0	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	0	1	2	3	4	5	6	7	8	9	10
1	-10	-9	-8	-6	-5	-4	-3	-2	-1	0	1	I	2	3	4	5	6	7	7	8	9	10

2	-10	-9	-7	-6	-5	-3	-2	-1	0	1	2	I	3	4	5	6	6	7	8	9	9	10
3	-10	-8	-7	-5	-4	-2	-1	0	1	2	3	I	4	5	6	6	7	8	8	9	9	10
4	-10	-8	-6	-4	-3	-1	0	1	2	3	4	I	5	6	6	7	8	8	9	9	10	10
5	-10	-7	-5	-3	-1	0	1	2	3	4	5	I	6	6	7	8	8	8	9	9	10	10
6	-10	-7	-4	-2	0	1	3	4	5	5	6	I	7	7	8	8	8	9	9	9	10	10
7	-10	-5	-2	0	2	3	4	5	6	6	7	I	7	8	8	9	9	9	9	10	10	10
8	-10	-4	0	2	4	5	6	7	7	8	8	I	8	9	9	9	9	9	10	10	10	10
9	-10	0	4	5	7	7	8	8	9	9	9	I	9	9	9	10	10	10	10	10	10	10
10	I	10	10	10	10	10	10	10	10	10	10	I	10	10	10	10	10	10	10	10	10	10

Table 1: Cayley's table of multiplying by 10.⊙

2.1 Neutrosophic DEMATEL using single-valued neutrosophic sets (SVNS)

Definition 8 Let X be a space of points (objects) with generic elements in X denoted by x. A single-valued neutrosophic set (SVNS) A in X is characterized by truth-membership function $TA(x)$, indeterminacy-membership function $IA(x)$, and falsehood membership function $FA(x)$. Then, an SVNS A can be denoted by $A = \{x, TA(x), IA(x), FA(x)\ x \in X\}$, where $TA(x), IA(x), FA(x) \in [0,1]$ for each point x in X. Therefore, the sum of $TA(x), IA(x)$ and $FA(x)$ satisfies the condition $0 \leq TA(x) + IA(x) + FA(x) \leq 3$.

Definition 9 Let $Ek = (T_k, I_k, F_k)$ be a neutrosophic number defined for the rating of the k-th decision-maker. Then, the weight of the k-th decision-maker can be written as:

$$\psi_k = \frac{1-\sqrt{[(1-T_k(x))^2+(I_k(x))^2+(F(x))^2]/3}}{\sum_{k=1}^{p}\sqrt{[(1-T_k(x))^2+(I_k(x))^2+(F(x))^2]/3}} \quad (2)$$

Further, in achieving a favorable solution, group decision-making is important in any decision-making process. In the group decision-making process, all the individual decision-maker assessments need to be aggregated into one aggregated neutrosophic decision matrix. This can be done by using a single-valued neutrosophic weighted averaging (SVNWA) aggregation operator as proposed by Ye [16], [26].

Definition 10 [16] Let $D^{(k)}=(d_{ij}^{(k)})_{mxn}$ be the single-valued neutrosophic decision matrix of the k-th decision-maker and $\psi = (\psi_1\psi_2, \dots, \psi_p)^T$ be the weight vector of decision-maker such that each $\psi_k \in [0,1], D = (d_{ij})_{mxn}$ where

$$d_{ij} = \langle 1 - \prod_{k=1}^{p}\left(1 - T_{ij}^{(p)}\right)^{\psi_k}, \prod_{k=1}^{p}\left(I_{ij}^{(p)}\right)^{\psi_k}, \prod_{k=1}^{p}\left(F_{ij}^{(p)}\right)^{\psi_k}\rangle \quad (3)$$

Definition 11 ([6], [17]) Deneutrosophication of SVNS Ñ can be defined as a process of mapping Ñ into a single crisp output $f: \tilde{N} \to \psi^*$ for $x \in X$. If Ñ is discrete set then the vector of tetrads $\tilde{N} = \{(x \mid T\tilde{N}(x), I\tilde{N}(x), F\tilde{N}(x)) \mid x \in X\}$ is reduced to a single scalar quantity $\psi * \in X$ by deneutrosophication. The obtained scalar quantity $\psi * \in X$ best represents the aggregate distribution of three membership degrees of neutrosophic element $T\tilde{N}(x), I\tilde{N}(x), F\tilde{N}(x)$. Therefore, the deneutrosophication can be obtained as follows.

$$\psi^* = 1 - \sqrt{[(1-T_k(x))^2 + (I_k(x))^2 + (\mathrm{F}(x))^2]/3} \quad (4)$$

Decision-making normally involves human language or linguistic variables, as it is commonly referred to. A linguistic variable simply represents words or terms used in human language. Therefore, this linguistic variable approach is a convenient way for decision-makers to express their assessments. Ratings of criteria can be expressed by using linguistic variables such as very influent (VI), influent (I), low influent (LI), not influent (NI), etc. Linguistic variables can be transformed into SVNSs as shown in Table 1.

Integer	Linguistic variable	SVNNs
0	No influence / Not important	(0.1,0.8,0.9)
1	Low influence/important	(0.35,0.6,0.7)
2	Medium influence/important	(0.5,0.4,0.45)
3	High influence/important	(0.8,0.2,0.15)
4	Very high influence/important	(0.9,0.1,0.1)

Table 2: Linguistic variable and Single-Valued Neutrosophic Numbers (SVNNs). Note: Source:[6]

To carry out the DEMATEL method in its neutrosophic variant, follow the steps outlined below [18]:

- Identify the elements of study: Through the application of semi-structured interviews to a population of interest and brainstorming, a set of influential factors in the subject under study is determined. [19]The

experts are then asked to evaluate the direct influence between the factors through paired comparisons, using the score shown in Table 2.

- Determine the relative importance of the experts: The group of experts has its importance values based on their level of experience and knowledge in the decision problem. Therefore, the weight of each decision-maker may be different from that of other deciders. The weight of each decision-maker is considered with linguistic variables and is transmitted in SVNN to later be identified using equation (2).
- Convert the linguistic evaluations given by the experts into SVNN: From the individual neat integer matrices obtained from the experts' evaluations, the individual neutrosophic matrices of the decision makers are constructed according to what is indicated in Table 2.
- Obtaining the initial direct relation matrix: To obtain the initial direct relation matrix that is in the form of neat numbers, the neutrosophic matrices of the individual decision-makers must be added and deneutrosophied using equations (3) and (4) respectively. [20], [25], [28], [29], [30]
- Identify cause-effect relationships between factors using the DEMATEL method: Based on the aggregate direct relationship matrix A obtained in step 4, the total relationship matrix T can be easily calculated using equations (5-7) as shown below:

$$D = A * S \tag{5}$$

Where

$$S = \frac{1}{\max\limits_{1\le i\le n} \sum_{j=1}^{n} a_{ij}} \tag{6}$$

Y

$$T=D*(ID)-1 \tag{7}$$

where I is the identity matrix. From this, the cause-effect relationship diagram $(ri + ci, ri - ci)$ is constructed.

- Analyze the cause-effect relationship diagram. The (ri+ci) is called “Prominence” and measures the degree of central role that the factor or criterion plays within the system. While (ri −ci) is called “Relationship” and is the effect produced by the factor or criterion in the system. If (ri -ci) >0, the factor or criterion is located in the group of causes. If (ri -ci) <0 the factor or criterion is located in the group of effects.

2.2 Methodology

In consultation with the specialists and through the revision of the base documents, the following elements are selected for the study:

- Increase in crime in the country and corruption inside prisons
- overcrowding
- Poor state of facilities and equipment in detention centers
- Lack of security personnel
- Lack of a good prison reform
- Weakening of the institutionality of the Ministry of Justice and Human Rights
- Insufficient budget to carry out the different projects
- More restrictive reforms in the Comprehensive Organic Criminal Code (COIP) of 2014

Taking these elements into account, the DEMATEL method is used to determine the possible causal relationships between these elements. The result of this analysis allows the focus of the interview to be carried out on the issues of greatest impact and relevance that are the true causes of the crisis, according to the selected experts. Five specialists who make up the working group are involved in this analysis. [21]

Subsequently, a questionnaire is applied to a sample of experts with years of experience in the field of study. The interview conducted with these experts is carried out through the use of linguistic variables. These allow a better understanding of the data, as well as a more accurate evaluation by the participants.

A group of 56 experts is selected to answer the questions prepared for the study. Each one of them is asked to rate the statements shown using a positive scale, up to 10 points if they have a favorable opinion on the subject analyzed. On the contrary, if they have an unfavorable opinion, they should make the rating on a scale of -10 to -1.

v_{ij}, $(i = 1,2,\dots,56;\ j = 1,2,\dots,n)$ is denoted as the evaluation of the i-th expert on the j-th aspect.

Subsequently, the calculation of $\bar{v}_i = \left(\frac{\sum_{j=1}^{n^+} v_{ij}^+}{n^+}, \frac{\sum_{j=1}^{n^0} v_{ij}^0}{n^0}, \frac{\sum_{j=1}^{n^-} v_{ij}^-}{n^-}\right)$ is made, where the positive responses of the i-th official on the j-th aspects are neutral, therefore, $\frac{\sum_{j=1}^{n^0} v_{ij}^0}{n^0} = 0$ and v_{ij}^- are negative responses. On the other hand n^+, n^0 and n^- are the numbers of positive, neutral, and negative responses, respectively. This new treatment guarantees greater precision in the results than the simple calculation of the arithmetic mean.

Afterward, $\hat{v}_i = round\left(\frac{\sum_{j=1}^{n^+} v_{ij}^+}{n^+}\right) \odot round\left(\frac{\sum_{j=1}^{n^-} v_{ij}^-}{n^-}\right)$ is calculated. In case both $round\left(\frac{\sum_{j=1}^{n^+} v_{ij}^+}{n^+}\right) = 10$ and $round\left(\frac{\sum_{j=1}^{n^-} v_{ij}^-}{n^-}\right) = -10$, it is defined that $\hat{v}_i = -10$.

The decision process is performed in two different situations:

1. If less than 30% of the respondents give conflicting results for each fixed j, that is, if there are 30 or fewer pairs of $(-10,10)$ or $(10,-10)$ values, these values are removed for aggregation.
2. Otherwise, the j-th aspect evaluates to "undefined" and why such a contradiction exists should be checked in more detail.

When the first case exists, the aggregation of $\hat{v}_i$ is calculated using $\odot$

3. Results

The application of the proposed method allowed to determine the existence of causality between the elements initially evaluated. Table 3 shows a summary of the main elements of interest that shed light on this topic.

Query elements	Ri+Ci	Ri-Ci
The weakening of the institutionality of the Ministry of Justice and Human Rights	8,572	0.106
Insufficient budget to carry out the different projects	6,501	0.037
Overcrowding	6.86	-0.254
The most restrictive reforms in the Comprehensive Organic Criminal Code (COIP) of 2014	6,739	-0.021
Increase in crime in the country and corruption inside prisons	7,449	0.979
The lack of a good prison reform	8.38	0.612
Poor state of facilities and equipment in detention centers	6,094	-1,246
Lack of security personnel	5,329	-0.213

Table 3: Results of the application of the DEMATEL method. Source: own elaboration.

As can be seen, the weakening of the institutionality of the Ministry of Justice and Human Rights, the deficient budget to carry out the different projects, the increase in crime in the country and corruption inside the prisons, as well as the lack of a good prison reform constitute the elements with the greatest relationship within the system studied. The relationship values indicate strong causality, meaning that these four items were more strongly associated with causative items than the others.

Taking into account what was previously analyzed, the interview to be applied to the sampled experts was more widely influenced by these 4 elements. In this way, it was possible to delve more strongly into causal elements whose elimination or minimization has a greater impact. In this sense, each of the four elements was broken down into 5 questions that seek to determine the level of status, according to the interviewees. Table 4 shows a summary of the main elements obtained, after compiling and tabulating the information.

		Scores			
Items	**Questions**	**[-10, -5)**	**[-5,0)**	**[0, 5)**	**[5, 10]**
The weakening of the institutionality of the Ministry of Justice and Human Rights	1	15	15	12	14
	2	13	11	21	11

	3	10	18	20	8
	4	6	10	21	19
	5	15	9	18	14
Insufficient budget to carry out the different projects	6	21	11	12	12
	7	23	9	21	3
	8	19	14	19	4
	9	17	20	15	4
	10	8	15	13	20
Increase in crime in the country and corruption inside prisons	11	24	12	15	5
	12	16	21	19	0
	13	16	14	20	6
	14	16	24	8	8
	15	24	12	15	5
The lack of a good prison reform	16	26	25	2	3
	17	22	19	6	9
	18	16	15	10	15
	19	19	17	11	9
	20	17	12	25	2

Table 4: Grouped data on the results of the applied survey. Source: own elaboration.

The results of the analysis showed an average value of 5. Although in general, these results are favorable, unfavorable responses were observed in those related to the budget to carry out the different activities, the increase in crime in the country, as well as as the non-existence of good prison reforms. [22]

In this sense, the lack of political and social will for the development of timely and efficient strategies for the deployment of activities and measures capable of promoting general changes in the country's prison policy was pointed out with greater force. Likewise, it was pointed out that effective actions are not carried out to minimize the factors of poverty, social marginalization, and violence, the main precursors of crime in the country. Finally, the poor planning of state budgets leads to the continuous decline of some of the rehabilitation centers to very disadvantaged conditions.

Conclusions

NeutroAlgebraic Structures and Antialgebraic Structures were introduced as an important application mechanism in everyday life, science, and engineering. The present study allowed the use of NeutroAlgebra theory to determine the factors with the greatest incidence in the poor state of the social rehabilitation system in Ecuador. Methods of generating ideas were carried out with the support of experts to obtain the elements to be evaluated focused on the canton of Babahoyos. Neutrosophic logic based on SVNS was applied to the DEMATEL method. The application of this method made it possible to determine the causal relationships between the initial elements and to focus the efforts of the interview to be carried out on the causal elements of the main problems.

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